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(71) Applicants
Robert Bosch GmbH,
Postfach 50, 7000
Stuttgart 1, Federal
Republic of Germany
(72) Inventors
Dieter Berghänel,
Jörg Zielfleisch
(74) Agents
W. P. Thompson & Co.,
Coopers Building, Church
Street, Liverpool L1 3AB

(54) **Electrical machine**

(57) A rolling bearing for the journalling of a shaft (10) in an electrical machine such as a motor vehicle alternator is constructed with a ball-bearing bush or sleeve (11) provided with two or more rows of balls (16, 17). The ball raceways on the inner ring (12) and in the outer ring (13) are cylindrical in form, thus allowing axial expansion of the shaft. The outer ring comprises a drawn sheet-metal component (11). Such a bearing is easier to lubricate and is less sensitive to angular displacement than a rolling bearing having rollers or needles.

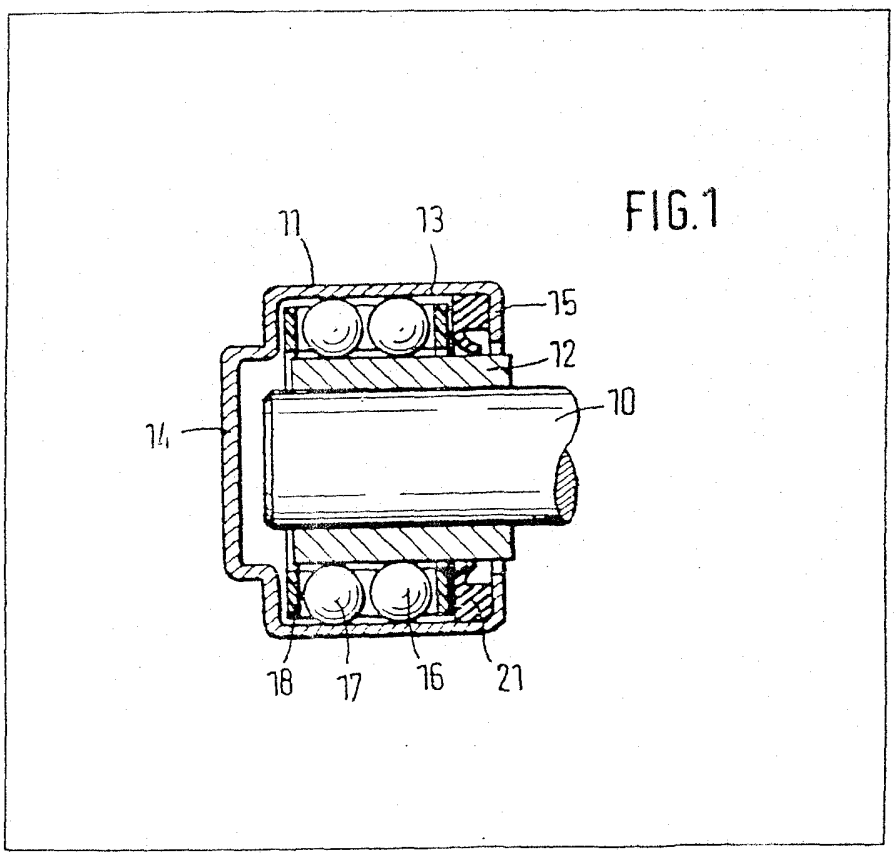

FIG.1

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FIG.1

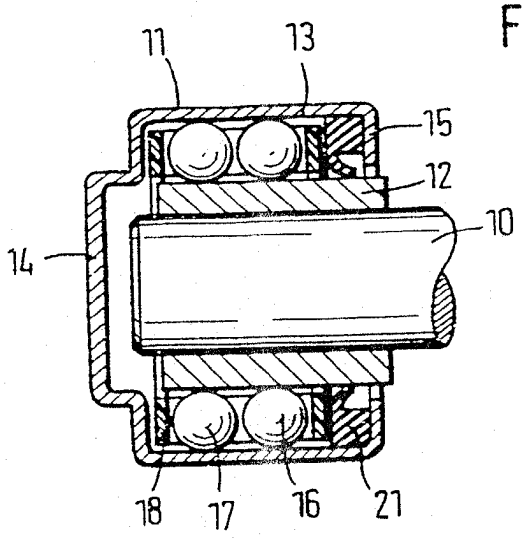
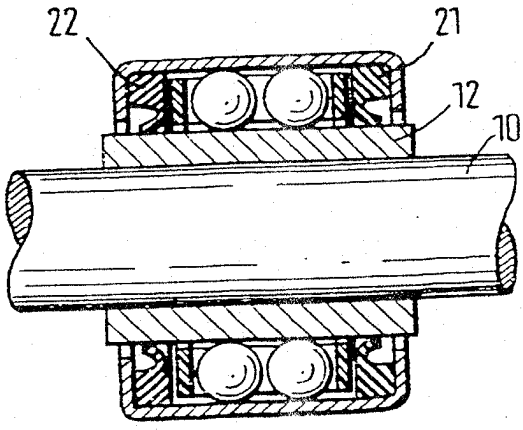


FIG.2



than two rows of balls. The balls 16 and 17 are located by a cage 18.

Two balls may be carried in a common cage pocket in the cage 18, or they may be arranged separately side by side, or separately in staggered formation. Advantageously, seals 21 and 22 may be provided at points of co-operation of the outer bush or sleeve 11 with the inner sleeve or ring 12.

The cylindrical raceways permit axial displacement of the shaft end relative to the adjoining portion of the housing. The other bearing (not illustrated) is an axially fixed bearing.

CLAIMS

1. An electrical machine comprising a machine housing containing a stator, a rotor, having a rotor shaft, and first and second bearings journalling the rotor shaft in the machine housing, the first bearing being axially rigidly clamped and the second bearing being a ball bearing having outer and inner cylindrical ball raceways and at least two rows of balls carried in a single cage and disposed between the raceways to permit relative axial displacement therebetween, the raceways being on outer and inner sleeves or bushes which are respectively fixed to the housing and the shaft.

2. A machine as claimed in claim 1, in which the balls are carried two abreast in a common cage pocket in the cage.

3. A machine as claimed in claim 1 or 2, in which the outer bearing bush is a drawn sheet-metal component.

4. An electrical machine, constructed substantially as herein described with reference to and as illustrated in the drawings.

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SPECIFICATION

Electrical machine

The invention relates to the bearings of electrical machines.

Electrical machines, in particular alternators in motor vehicles, are often subjected to substantial variations in temperature during operation. The temperature variations may be due, for example, to self-heating or to heating or cooling due to environmental conditions. In such cases particular attention must be paid to mechanical deformation caused by differential expansion due to temperature variations. Particularly in cases where the rotor shaft is made of steel and the machine housing is made of aluminium, substantial mechanical stresses are created in the bearings of the rotor shaft owing to the coefficient of expansion of aluminium being approximately twice that of steel. In known machines, the problem has been solved by the clamping of one bearing axially rigidly in the machine housing, the temperature-dependent differential expansion of shaft and housing being compensated for by a floating second bearing. If a conventional ball bearing is used, the inner ring of the second bearing is pressfitted on the rotor shaft, and the outer ring is axially movably arranged in the bearing bush.

A disadvantage of the known machines provided with conventional ball bearings is that the bore for the movable bearing is often beaten out of shape owing to the stress caused by variations in temperature, and in particular on an increase in rotational forces. This trouble occurs in particular in generators applied to internal combustion engines. A further disadvantage is that radial movement of the outer ring of the conventional ball bearing must be prevented by means of a rotary lock.

In machines provided with sliding bearings, these problems do not arise in the described form. However, sliding bearings often cannot be used because of other operating conditions, such as frequent substantial engine-speed variations and the possibility of providing trouble-free lubrication.

Neither in the difficult service conditions described are needle bearings utilisable without adaptation. It is true that needle bearings permit longitudinal compensation when subjected to variations in temperature, and that they also have a higher loading coefficient than ball bearings; on the other hand, however, needle bearings are extremely sensitive to angular displacement of the machine shaft in the bearing boss.

An electrical machine according to the invention comprises a machine housing containing a stator, a rotor, having a rotor shaft, and first and second bearings journalling the rotor shaft in the machine housing, the first bearing being axially rigidly clamped, and the second bearing being a ball bearing having outer and inner cylindrical ball to permit relative axial displacement there between, the raceways being on outer and inner sleeves or bushes which are respectively fixed to the housing and the shaft.

This has the advantage that the seating bore in the bearing boss cannot be beaten out or become enlarged since the bearing may be considered as one which remains rigidly clamped throughout the entire temperature range. The bearing is unaffected by angular displacement. Lastly, the supporting-element function is transferred from the bearing itself to the bearing boss, which can be as strong as necessary in construction, irrespective of other requirements to which the rolling bearing may be subject.

It is particularly significant that a rotary lock for the outer ring is no longer necessary. In particular in generators for motor vehicles, which are subjected to substantial vibrational stresses, the steel-lined bush — that is, a steel bush pressfitted into an aluminium end shield — can be eliminated. The cost of manufacture of the end shield is also reduced, since a through bore may be used instead of the otherwise necessary blind bore. All in all, the bearing element is less expensive than the conventional grooved ball bearing, since the sleeve or bush which serves as the outer bearing track may be manufactured in the form of a drawn sheet metal component. In the event of damage to the bearing, the bearing bush can be easily removed and replaced.

The invention is further described, by way of example, with reference to the drawings, in which:—

Fig. 1 is a sectional view of one bearing of a rotary electrical machine in accordance with the invention, and

Fig. 2 is a similar view of another bearing.

As shown in Fig. 1, one rolling bearing of a rotary electrical machine according to the present invention comprises an outer bearing bush 11 and an inner bearing sleeve or ring 12, which is mounted on a machine shaft 10 which carries the rotor (not shown). The outer bearing bush 11 is received in the machine housing (not shown) which receives the stator. The outer bearing bush 11 comprises a cylindrical peripheral portion 13, whose inner cylindrical surface serves at the same time as the outer bearing raceway an end portion 14, and a flanged portion 15. The inner bearing sleeve 12 has an external cylindrical surface which forms the inner bearing raceway. The inside diameter of the flanged portion 15 is such that the inner ring 12 can be inserted in the outer bush 11. In the embodiment shown in Fig. 1 of the drawings, the end portion 14 is of cup-shaped construction. Alternatively, however, it may be planar or grooved. Like the flanged portion 15, the end portion may also have a bore somewhat larger in diameter than the outer diameter of the inner raceway 12. Such an embodiment is shown in Figure 2.

Preferably two rows of balls 16 and 17 are